Scilab Textbook Companion for Electronic Communication by D. Roddy[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Passive Circuits

Scilab code Exa 1.2.2 `example 2`

```
clc;
// page no 5
// prob no 1_2_2
//T-type attenuator provide 6-dB insertion loss
//All resistance are in ohm
Ro=50
ILdB=6
IL=10^-(ILdB/20)
//Determination of R
R=Ro*(1-IL)/(1+IL)
disp('ohm',R,+'The value of resistance R is')
//Determination of R3
R3=(2*Ro*IL)/(1-(0.5)^2)
disp('ohm',R3,+'The value of resistance R3 is')
```

Scilab code Exa 1.2.3 `example 3`

```
clc;
```

```
// page no 7
// prob no 1_2_3
//pi-attenuator with 6 dB insertion loss
//output resistance is Ro=50 ohm
//All resistance are in ohm
Ro=50
ILdB=6
IL=10^-(ILdB/20)
//Determination of RA and RB
RA=Ro*(1+IL)/(1-IL);
disp('ohm',RA,+'The value of resistance RA and RB is
    ')
//Determination of RC
RC=Ro*(1-(IL)^2)/(2*IL);
disp('ohm',RC,+'The value of resistance RC is')
```

Scilab code Exa 1.2.4 example 4

```
clc;
// page no 9
// prob no 1_2_4
//As given in fig. 1.2.4 L-attenuator with source
    resistance Rs=75 ohm and load resistance Rl=50
    ohm
Rs=75; Rl=50;
//Determination of R1
R1=(Rs*(Rs-Rl))^(1/2);
disp('ohm',R1,+'The value of resistance R1 is');
//Determination of R3
R3=((Rs^2)-(R1^2))/R1;
disp('ohm',R3,+'The value of resistance R3 is');
//Determination of insertion loss
IL=(R3*(Rs+R1))/((Rs+R1+R3)*(R3+R1)-(R3)^2)
ILdB=-20*log10(IL);//convertion of power in decibels
disp('dB',ILdB,+'The value of insertion loss is');
```

Scilab code Exa 1.2.5 example 5

```
clc;
// page no 10
// prob no 1_2_5
//As given in fig. 1.2.4 L−attenuator with source
   resistance Rs=10 ohm and load resistance Rl=50
   ohm
Rs=10; Rl=50;
//Determination of R2
R2=(Rl*(Rl-Rs))^(1/2);
disp('ohm',R2,+'The value of resistance R2 is');
//Determination of R3
R3=((Rl^2)-(R2^2))/R2;
disp('ohm',R3,+'The value of resistance R3 is');
//Determination of insertion loss
IL=(R3*(Rs+Rl))/((Rs+R3)*(R3+R2+Rl)-(R3)^2)
ILdB=-20*log10(IL);//convertion of power in decibels
disp('dB',ILdB,+'The value of insertion loss is');
```

Scilab code Exa 1.5.1 example 6

```
clc;
// page no 21
// prob no 1_5_1
//Series tuned resonant ckt is given which is tuned
   at 25 MHz with
//series resistance 5 ohm self capacitance 7 pF and
   inductance 1 uH
C=7*10^-12;R=5;L=10^-6;f=25*10^6;
//Determination of self resonant freq of coil
   denoted as Fsr
```

```
Fsr=1/(2*3.14*(L*C)^0.5);
disp('MHz',Fsr/(10^6),+'The value of self resonant
   freq is');
//Determination of Q-factor of coil,excluding self-
   capacitive effects
Q=(2*3.14*f*L)/R;
disp(Q,'The value of Q-factor is');
//Determination of effective inductance
Leff=L/(1-(f/Fsr)^2);
disp('uH',Leff*(10^6),+'The value of effective
   inductance is');
//Determination of effective Q-factor
Qeff=Q*(1-(f/Fsr)^2);
disp(Qeff,'The value of effective Q-factor is');
```

Scilab code Exa 1.8.1 example 7

```
clc;
// page no 26
// prob no 1_8_1
//High frequency transformer with identical primary
   and secondary circuits
Lp=150*10^-6;
Ls=150*10^-6;
Cp=470*10^-12;
Cs=470*10^-12;
//Lp=Ls=150 uH,Cp=Cs=470 pF
Q=85//Q-factor for each ckt is 85
c=0.01//Coeff of coupling is 0.01
Rl=5000//Load resistance Rl=5000 ohm
r=75000//Constant current source with internal
   resistance r=75 kohm
//Determination of common resonant frequency
wo=1/((Lp*Cp)^(1/2));
//disp('Mrad/sec',wo/(10^6),+'The value of common
```

```
    resonant freq is');
p=3.77*10^6;
Z2=Rl/(1+(p*%i*Cs*Rl));
Z1=r/(1+(p*%i*Cp*r));
// At resonance Zs=Zp=Z
Z=wo*Ls*(1/Q +%i);
Zm=%i*p*c*Lp;
// Determination of denominator
Dr=((Z+Z1)*(Z+Z2))-(Zm^2)
// Hence transfer impedance is given as
Zr= (Z1*Z2*Zm)/Dr;
disp('ohm',Zr,'The transfer impedance is');
```

Scilab code Exa 1.10.1 `example 8`

```
clc;
// page no 34
// prob no 1_10_1
//From the ckt of fig. 1.10.1(a)
C1=70*10^-12
C2=150*10^-12
Rl=200
Q=150
f=27*10^6
r=40000
//Determination of common resonant freq
wo=2*3.14*f;
disp('Mrad/sec',wo/(10^6),+'The value of common
    resonant freq is');
//Determination of Gl
Gl=1/Rl;
disp('mSec',Gl*(10^3),+'The value of Gl is');
//Checking the approxiamtion in denominator
ap=((wo*(C1+C2))/(Gl))^2
alpha=(C1+C2)/C1;
```

```
disp(alpha,'The value of alpha is ')
//Determination of effective load
Reff=((alpha)^2)*Rl;
disp('kohm',Reff/(10^3),+'The value of effective load is');
//If effective load is much less than internal resistance hence tuning capacitance then
Cs=C1*C2/(C1+C2);
disp('pF',Cs*(10^12),+'The value of tuning capacitance is');
//Determination of Rd
Rd=Q/(wo*Cs);
disp('kohm',Rd/(10^3),+'The value of Rd is');
//If Rd is much greater than Reff then -3dB bandwidth is given by
B=1/(2*3.14*C2*alpha*Rl);
disp('MHz',B/(10^6),+'The value of -3dB BW is');
```

Chapter 2

WAVEFORM SPECTRA

Scilab code Exa 2.13.1 example 1

```
clc;
//page no 74
//prob no. 2.13.1
//A rectangular pulse with h=3V and width=2ms across
    10 ohm resistor
V=3;t=2*10^-3;R=10;
//Determination of average energy
P=(V^2)/R;//Instantaneous power
U=P*t;
disp('J',U,'The average energy is');
```

Chapter 4

Noise

Scilab code Exa 4.2.1 `example 1`

```
clc;
// page no 120
// prob no 4_2_1
//Resistor at room temp T=290 K with BW=1MHz and R=50 ohm
T=290
BW=1*10^6// Noise bandwidth in hertz
k=1.38*10^-23 //Boltzman constant in J/K
R=50
//Determination of thermal noise power Pn
Pn=k*T*BW;
disp('W',Pn,+'The value of thernal noise power is');
//Determination of RMS noise voltage
En=(4*R*k*T*BW)^(1/2);
disp('uV',En*(10^6),+'The value of RMS noise voltage is');
```

Scilab code Exa 4.2.2 `example 2`

```
clc;
// page no 122
// prob no 4_2_2
//Two resistor at room temp are given with BW=100KHz
R1=20000
R2=50000
k=1.38*10^-23 //Boltzman constant in J/K
T=290
BW=100*10^3
//Determination of thermal noise voltage for 20Kohm resistor
En1=(4*R1*k*T*BW)^(1/2);
disp('uV',En1*(10^6),+'a)i)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 50 kohm resistor
En2=En1*(R2/R1)^(1/2);
disp('uV',En2*(10^6),+'a)ii)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 20K & 50k resistor in series
Rser=R1+R2// Series combination of R1 & R2
En3=En1*(Rser/R1)^(1/2);
disp('uV',En3*(10^6),+'b)The value of RMS noise voltage is');
//Determination of thermal noise voltage for 20K & 50k resistor in parellel
Rpar=(R1*R2)/(R1+R2)// parallel combination of R1 & R2
En4=En1*(Rpar/R1)^(1/2);
disp('uV',En4*(10^6),+'c)The value of RMS noise voltage is');
```

Scilab code Exa 4.2.3 `example 3`

```
clc;
// page no 128
// prob no 4_2_3
//Parallel tuned ckt tuned at resonant freq f=120 MHz
f=120*10^6;
c=25*10^-12;//capacitance of 12 pF
Q=30;//Q-factor of the ckt is 30
BW=10*10^3;//cahnnel BW of the receiver is 10 KHz
k=1.38*10^-23 //Boltzman constant in J/K
T=290;//Room temp
//Determination of effective noise voltage Rd apearing at i/p at room temp
 Rd=Q/(2*%pi*f*c);
 disp('kohm',Rd/1000,'The value of Rd is ');
 Vn=(4*Rd*k*T*BW)^(1/2);
disp('uV',Vn*(10^6),'The value of effective noise voltage is');
```

Scilab code Exa 4.3.1 example 4

```
clc;
// page no 131
// prob no 4_3_1
//Direct current of 1 mA flowing across semiconductor junctn
Idc=10^-3;
Bn=10^6;//Effective noise BW=1 MHz
q=1.6*10^-19;//Charge on electron in coulombs
//Determination of noise component current In in DC current of Idc=1 mA
In=(2*Idc*q*Bn)^(1/2);
disp('nA',In*(10^9)','The value of noise current In is ')
```

Scilab code Exa 4.11.1 `example 5`

```
clc;
// page no 135
// prob no 4_11_1
//An amplifier is given
Rn=300;//Equivalent noise resistance
Ieq=5*10^-6;//Equivalent noise current is 5 uA
Rs=150;//Amplifier fed from 150 ohm,10 uV rms sinusoidal source
Vs=10*10^-6;
Bn=10*10^6;//Noise BW is 10 MHz
//Assume the following
kT=4*10^-21;//k is Boltzman constant in J/K & T is room temp
q=1.6*10^-19;//Charge on electron in coulombs
//Determination of shot noise current
Ina=(2*q*Ieq*Bn)^(1/2);
disp('nA',Ina*(10^9)','The value of shot noise current Ina is ');
//Noise voltage developed by this across source resistance is
V=Ina*Rs;
disp('uV',Vs*(10^6)','The value of noise voltage across Rs is ');
//Noise voltage developed across Rn resistance is
Vna=(4*Rn*kT*Bn)^(1/2);
disp('uV',Vna*(10^6)','The value of noise voltage across Rn is ');
//Determination of thermal noise voltage from source
Vns=(4*Rs*kT*Bn)^(1/2);
disp('uV',Vns*(10^6)','The value of thermal noise voltage at Rs is');
//Determination of total noise voltage at input
```

```
Vn=(((V)^2)+((Vna)^2)+((Vns)^2))^(1/2)
disp('uV',Vn*(10^6)','The value of total noise voltage Vn is ');
//Determination of signal to noise ratio in dB
SNR=20*(log10(Vs/Vn));
disp('dB',SNR,'The value of signal to noise ratio is ');
```

Scilab code Exa 4.12.1 example 6

```
clc;
// page no 136
// prob no 4_12_1
//As shown in fig 4.12.1
//Three identical links are given with for 1 link is SNR=60 dB
SNR1=60;
l=3;
//Determination of output signal to noise ratio
SNR=(SNR1)-10*log10(l);
disp('dB',SNR,'The value of output signal to noise ratio is ');
```

Scilab code Exa 4.12.2 example 7

```
clc;
// page no 137
// prob no 4_12_2
//SNR for three links is given in which Ist two have SNR 60 db & IInd 40 dB
SNRdB(1)=60;//SNR is 60 dB for Ist link
SNRdB(2)=60;//SNR is 60 dB for IInd link
SNRdB(3)=40;//SNR is 40 dB for IIIrd link
```

```
//Determination of power in watt
for i=1:3
snr(i)=10^(-SNRdB(i)/10);
end;
//Determination of overall SNR
for i=1:3
SNR=snr(i);
end;
//Determination of total SNR in dB
SNRdB=10*(-log10(SNR));
disp('dB',SNRdB,'The value of output signal to noise ratio is ');
```

Scilab code Exa 4.13.1 example 8

```
clc;
// page no 139
// prob no 4_13_1
//Noise fig. of an amplifier is 7 dB with input SNR=35 dB
SNRin=35;//SNR at i/p of amplifier
F=7;//Noise figure of an amplifier
//Determination of output SNR
SNRout=SNRin-F;
disp('dB',SNRout,'The value of output signal to noise ratio is ');
```

Scilab code Exa 4.14.1 example 9

```
clc;
// page no 140
// prob no 4_14_1
//Noise fig. of an amplifier is 13 dB with BW=1MHz
```

```
f=13;//Noise figure of an amplifier
Bn=1*10^6;
kT=4*10^-21;//k is Boltzman constant in J/K & T is room temp
F=10^(f/10);
//Determination of equivalent amplifier input noise
Pna=(F-1)*kT*Bn;
disp('pW',Pna*10^12,'The value of input noise is');
```

Scilab code Exa 4.15.1 `example 10`

```
clc;
// page no 141
// prob no 4_15_1
//mixer with noise fig. 20dB preceded by amplifier with noise fig. 9dB is given
f1=9;//Noise fig for amplifier
f2=20;//Noise fig for mixer
g=15;//power gain
//Converting dB in power ratio
F1=10^(f1/10);
F2=10^(f2/10);
G=10^(g/10);
//Determination of overall noise fig. reffered at i/p
F=F1+(F2-1)/G;
//converting in dB
FdB=10*log10(F);
disp('dB',FdB,'The overall noise fig is');
```

Scilab code Exa 4.17.1 `example 11`

```
clc;
```

```
// page no 143
// prob no 4_17_1
//An attenuator is given with insertion loss of 6 dB
//Noise fig is equivalent to insertion loss
F=6;//Noise fig.=6 dB
//Determination of noise factor
Fn=10^(6/10);
disp(Fn,'The value of noise factor is ');
```

Scilab code Exa 4.18.1 `example 12`

```
clc;
// page no 144
// prob no 4_18_1
//A receiver with noise fig. 12dB fed by low noise amplr with gain  50 dB with noise temp of 90 k
f=12;
Tm=290;//Room temp value
T=90;
g=50;
//calculating power ratio
F=10^(f/10);
G=10^(g/10);
//Determination of equivalent noise at room temp
Tem=(F-1)*Tm;
disp('K',Tem,'The value of equivalent noise at room temp is');
//Determination of equivalent noise at 90 k temp
Te=T+(Tem/G);
disp('K',Te,'The value of equivalent noise at noise temp=90 is');
```

Scilab code Exa 4.19.1 `example 13`

```
clc;
// page no 146
// prob no 4_19_1
//An avalanche diode source is given with excess
    noise ratio is 14 dB
enr=14;
To=290;//Room temp in K
y=9;//Y-factor  is 9 dB
//converting dB in power ratio
ENR=10^(enr/10);
Y=10^(y/10);
//From def of ENR the hot temp is
Th=To*(ENR+1);
disp('K',Th,'The value of hot temp Th is ');
//Determination of equivalent noise temp
Te=(Th-(Y*To))/(Y-1);
disp('K',Te,'The value of equivalent noise temp Te
    is ');
```

Chapter 5

TUNED SMALL SIGNAL AMPLIFIERS MIXERS AND ACTIVE FILTERS

Scilab code Exa 5.4.1 example 1

```
//page no 162
// problem no 5.4.1
//Resonating freq of a tuned ckt of a CE amplifier
   is 5MHz
f=5*10^6;
c=100*10^-12;//tuning capacitance in F
Q=150;// Q-factor of the ckt
Rl=5*10^3;//load resistance in ohm
Rc=40*10^3;//o/p reistance of transistor
Ic=500*10^-6;//transister collector current in A
C=0.6*10^-12;//collector to base capacitance in F
Vt=26*10^-3;//thermal voltage in V
//transe conductance is given as
gm=Ic/Vt;
RD2=Q/(2*%pi*f*c);
// At resonance the output admittance is purely
   conductive and is given as
```

```
Yo=(1/Rc)+(1/RD2)+(1/Rl);
//The voltage gain is given as
Av=-(gm/Yo);
disp(Av,'The voltage gain is');
//The Millar capacitance is given as
Cm=(1-Av)*C;
disp('pF',Cm*10^12,'The Millar capacitance is');
```

Scilab code Exa 5.4.2 example 2

```
clc;
//page no 163
// problem no 5.4.2
//Resonating freq of a tuned ckt of a CE amplifier
   is 5MHz
f=5*10^6;//in Hz
w0=2*%pi*f;
Q=100;//Q-factor of the ckt
L=2*10^-6;//inductance expressed in H
Rs=1000;//source resistance in ohm
Ic=500*10^-6;//transister collector current in A
Vt=26*10^-3;//thermal voltage in V
hfe=200;
C_be=10*10^-12;//in pF
// refer to problem 5.4.1
Av=78;
Cm=47;
gm=Ic/Vt;
r_be=hfe/gm;
// The dynamic resistance of the tuned ckt is
RD1=Q*w0*L;
//The effective dynamic conductance is
RD1eff_1=(1/Rs)+(1/RD1)+(1/r_be);
RD1_eff=1/RD1eff_1
// Tha effective Q-factor is
```

```
Qeff=RD1_eff/(w0*L);
disp(Qeff,'The effective Q-factor is');
// The voltage gain refered to source is
Avs=RD1_eff*Av/Rs;
disp(Avs,'The voltage gain is');
```

Chapter 6

Oscillators

Scilab code Exa 6.3.1 `example 1`

```
clc;
//page no 199
// prob no 6.3.1
// RC phase shift scillator
// In the given problem small-signal o/p resistance Rc=40kohm
// collector bias resistor , rc=10kohm,f=400 Hz;
// all resistances are in Kohm and freq in Hz
f=400;rc= 10; Rc= 40;
// Minimum value of beta is given by Bomin= 23+(4*Ro/R)+(29*R/Ro)
// For minimum beta Ro/R=2.7, we represent Ro/R=b
b=2.7;
Bomin=23+(4*b)+(29*1/b);
disp(Bomin,'1.The minimum value of beta is');
//Determination of R and C components
//R0 is given by (rc*Rc)/(rc+Rc)
R0=(rc*Rc)/(rc+Rc);
R=2.7* R0;
disp('Kohm',R,+'2.The value of resistor R=');
c=1/(2*%pi*f*R*sqrt(6+(4*b)))*10^9;
```

```
disp('pF',c,+'3.The value of capacitor is ');
```

Scilab code Exa 6.3.2 `example 2`

```
clc;
// page no 200
// prob no 6.3.2
// RC phase shift oscillator
// all resistors are in Kohm
f=800;R0=18;
// R>>Ro should be chosen to minimize the effect of Ro on frequency. A number of values for R can be tried, and it will be found that R=100Kohm is reasonable.
R=100;
c=1/(2*%pi*f*R*sqrt(6+(4*R0/R)))*10^9;// C in pF
disp('pF',c,+'The value of capacitor is ');
```

Scilab code Exa 6.3.3 `example 3`

```
clc;
// page no 201
// prob no 6_3_3
// RC pase shift oscillator
// All resistors are in Kohm
f=1000; Ro=5;
//Choose R&gt;&gt; R0 to minimize the effects of R0 on frequency. Select R=100kohm
R=100;
c=1/(2*%pi*f*R*sqrt(6+(4*Ro/R)))*10^9;
disp('pF',c,+'The value of capacitor is ');
// The required open -circuit voltage gain is
Ao= 29+23*(Ro/R)+4*(Ro/R)^2;
```

```
disp(Ao,'1.The required open -circuit voltage gain
   is');
gm=Ao/Ro;
disp('mS',gm,+'2.The value of gm is');
```

Scilab code Exa 6.4.1 example 4

```
clc;
// page no 205
// prob no 6_4_1
// colpitt's oscillator
L=400*10^-6;// in H
c1= 100;// in pF
c2= 300;// in pF
Q=200;
Ro= 5*10^3;
Bo=100;//beta value
// The tuning capacitance is
Cs=(c1*c2/(c1+c2));
disp('pF',Cs,+'1.The value of capacitor is ');
//  the frequency of oscillation is obtained as
f=1/(2*%pi*sqrt(L*Cs*10^-12));
disp('Hz',f,'2.The frequency of oscillation is');
// The dynamic impedence of the tuned circuit
wo= 2*%pi *f;
Rd=Q/(wo*Cs*10^-12);
disp('ohm',Rd,+'3.The dynamic impedence of the tuned
    circuit');
// The coil series resistance is
r=wo*L/Q;
disp('ohm',r,+'4.The coil series resistance is ');
//The capacitor raio c= c1/c2=1/3, and therefore 1-
   c2/B0*c1 = 1 .
// The starting value of gm is therefore given by
c= c1/c2;
```

```
gm=(1/Ro)*c +(c+3+2)*(1/Rd);
disp('sec',gm,+'5.The value of gm is');
// Assuming the input resistance is that of the
    transistor alone,
R1=Bo/gm;
disp('ohm',R1,+'6.The input resistance is');
//The actual starting frequency is obtained from wo
    ^2=(1/LCs)+(1/R1R2C1C2)
wo2=1/((L*Cs*10^-12)+(1/R1*Ro*c1*c2*10^-12*10^-12));
wo=sqrt(wo2);
// Hence the frequency is
f=wo/(2*%pi);
disp('Hz',f,'7.The frequency of oscillation is');
```

Scilab code Exa 6.6.1 example 5

```
clc;
// page no 211
// prob no 6.6.1
//In given problem zero bias capacitance co is 20pF
Co=20;// in pF
Vd=-7;// reverse bias voltage in volt
//constant pottential of junction is 0.5
a=0.5;// for abrupt junction
Cd=Co/(1-(Vd/0.5))^a;
disp('pF',Cd,+'The value of capacitor is ');
```

Scilab code Exa 6.6.2 example 6

```
clc;
// page no 212
// prob no 6.6.2
//Voltage controlled Clapp oscillator
```

```
// Capacitor is in pF and inductor in uH
C1=300; C2=300; Cc=20; L=100;
// A) With zero applied bias ,the total tuning
   capacitor is
Vd1=0;a=0.5;Co=20;
Cd1=Co/(1-(Vd1/0.5))^a;
Cs1=1/((1/C1)+(1/C2)+(1/Cc)+(1/Cd1));
disp('pF',Cs1, +'1.The total tuning capacitor is');
// The frequency of oscillation is
f=1/(2*%pi*sqrt(L*10^-6*Cs1*10^-12));
disp('Hz',f,'2.The frequency of oscillation is');
// B) With a reverse bias of -7 v, the tuning
   capacitance becomes
Vd2=-7;
Cd2=Co/(1-(Vd2/0.5))^a;
Cs2=1/((1/C1)+(1/C2)+(1/Cc)+(1/Cd2));
disp('pF',Cs2, +'3.The total tuning capacitor is');
// The frequency of oscillation is
f=1/(2*%pi*sqrt(L*10^-6*Cs2*10^-12));
disp('Hz',f,'4.The frequency of oscillation is');
```

Chapter 7

RECEIVERS

Scilab code Exa 7.3.1 `example 1`

```
clc;
//page no 227
//prob no. 7.3.1
//An RF receiver tunes signal in 550-1600kHz with IF =455kHz
fs_min=550*10^3;fs_max=1600*10^3;IF=455*10^3;
//Determination of freq tuning ranges
fo_min=fs_min+IF;
fo_max=fs_max+IF;
disp('Hz',fo_max,'fo_max=','Hz',fo_min,'fo_min=','The freq tuning range is');
Rf=(fo_max)/(fo_min);//calculation of freq tuning range ratio
disp(Rf,'Rf=','The tuning range ratio of oscillator is');
Rc=Rf^2;//calculation of capacitance tuning range ratio
disp(Rc,'Rc=','The capacitor tuning range ratio of oscillator is');
//For RF section
Rf1=fs_max/fs_min;
```

```
disp(Rf1,'Rf=','The tuning range ratio of RF-ckt is');
Rc1=Rf1^2;
disp(Rc1,'Rc','The capacitor tuning range ratio of RF-ckt is');
```

Scilab code Exa 7.4.1 example 2

```
clc;
//page no 230
//prob no. 7.4.1
//Refer example 7.3.1
//2-tuning capacitor with max 350pF/section ^ capacitance ratio in eg. 7.3.1
Rco=8.463;Rfo=2.909;Rcs=4.182;Rfo=2.045;fo_max=2055*10^3;fo_min=1005*10^3;
Cs_max=350*10^-12;
//For the RF section
Cs_min=Cs_max/Rcs;
disp('F',Cs_min,'The Cs_min is');
```

Scilab code Exa 7.6.1 example 3

```
clc;
//page no 234
//prob no. 7.6.1
// An AM broadcast receiver with following specifications is given
IF=465;//IF in KHz
fs=1000;//Tuning freq in KHz
Q=50;//Quality factor
// Oscillator freq fo is given as
fo=fs+IF;
```

```
// a) Image freq is given as
fi=fo+IF;
disp('KHz',fi,'Image freq is');
y=fi/fs - fs/fi;
// b) image rejection is given as
Ar=1/sqrt(1+(y*Q)^2);
Ar_dB=20*log10(Ar);
disp('dB',Ar_dB,'Image rejection is');
```

Scilab code Exa 7.7.1 example 4

```
clc;
//page no 236
//prob no. 7.7.1
// refer to example 7.3.1
// A broadcast receiver is tuned to a signal with
fs=950;//in KHz
IF=455;//in KHz
m=[1,2];
n=[1,2];
f0=fs+IF;
disp('The sum of frequencies are');
for i=1:1:2
    for j=1:1:2
fu1=n(j)/m(i) *f0 + 1/m(i) *IF;
disp(fu1);
end
end
disp('The difference of frequencies are');
for i=1:1:2
    for j=1:1:2
fu2=n(j)/m(i) *f0 - 1/m(i) *IF;
disp(fu2);
end
end
```

Chapter 8

AMPLITUDE MODULATION

Scilab code Exa 8.3.1 `example 1`

```
clc;
//page no 257
//prob no. 8.3.1
//A modulating signal with zero dc component & vpp
    =11,vcp=10 carrier peak voltage
vpp=11;//peak to peak voltage of modulating signal
vcp=10;//carrier peak voltage
//Determination of modulation index
E_max=vcp+(vpp/2);
E_min=vcp-(vpp/2);
m=(E_max-E_min)/(E_max+E_min);
disp(m,'The modulation index is');
//determination of kratio of side lengths
L1_L2=E_max/E_min;
disp(L1_L2,'The ratio of side lengths L1/L2 is');
```

Scilab code Exa 8.5.1 `example 2`

```
clc;
//page no 260
//prob no. 8.5.1
//A carrier with fc=10MHz & vp=10V modulated with fm
   =5kHz & Vm=6V
fc=10*10^6;//Carrier freq
fm=5*10^3;//Modullating freq
vp=10;vm=6;
//Determination of modulation index
m=vm/vp;
disp(m,'The modulation index is');
```

Scilab code Exa 8.7.1 example 3

```
clc;
//page no 263
//prob no. 8.7.1
//AM radio Tx=10A when unmodulated & 12A when
   modulated
I=12;Ic=10;
//Determination of modulation index
m=sqrt(2*(((I/Ic)^2)-1));
disp(m,'The modulation index is');
```

Scilab code Exa 8.11.1 exampple 4

```
clc;
//page no 274
//prob no. 8.11.1
//RC load ckt for diode detector with c=1000pF in
   paralel with R=10Kohm
fm=10*10^3;//modulation freq
c=1000*10^-12;R=10*10^3;
```

```
Yp=(1/R)+((%i)*2*(%pi)*fm*c);//admittance of RC load
disp(Yp);
Zp=1/sqrt((real(Yp)^2)+(imag(Yp)^2));
disp(Zp);
//Determination of max modulation index
m=Zp/R;
disp(m,'The max modulation index is');
```

Chapter 9

SINGLE SIDEBAND MODULATION

Scilab code Exa 9.2 example 1

```
clc;
// page no 349
// prob no 9.2
Nd=7; N_start=1; N_stop=1; N_parity=1;
Nt= Nd + N_start+ N_stop + N_parity;
efficiency=Nd/Nt *100;
disp('%',efficiency,'The efficiency is');
```

Scilab code Exa 9.6 example 2

```
clc;
// page no 358
// prob no 9.6
m=21;
// The correct number of check bits is the smallest
   number that satisfy the equation 2^n >= m+n+1;
```

```
for n=1:1:10 // we choose range of 1 to 10
    a=m+n+1;
    b=2^n;
    if(b>=a)
        disp(n,'hammming bits are required')
        break;
    end
end
```

Chapter 10

Angle Modulation

Scilab code Exa 10.12.1 `example 1`

```
clc;
//page no 343
//problem no 10.12.1
p=10;t=0.3*10^-6;gm=2*10^-3;
q=1/p;f_max=q/(2*%pi*t);
Z2=p/gm;
R2=Z2;//Z2 is resistance
//Determination of equivalent tuning capacitance
C1=t/R2;
Ceq=gm*t;
disp('f',Ceq,'The equivaent tuning capacitance is');
```

Scilab code Exa 10.13.1 `example 2`

```
clc;
//page no 349
//problem no 10.13.1
del_phi_d=12;f_min=100;del_f_max_allow=15000;
```

```
del_phi_rad=(12*%pi)/180;
del_f_max=del_phi_rad*f_min;
//Determination of freq deviation
N=del_f_max_allow/del_f_max;
l=del_f_max*729;//using six tripler
f=0.1*729;
//Determination of signal oscillator signal
fo=152-f;
disp('MHz',fo,'fo is best obtained by using two
   tripler');
```

Chapter 11

PULSE MODULATION

Scilab code Exa 11.3.1 example 1

```
clc;
//page no 392
//prob no. 11.3.1
//PCM system with SNR=40dB & rms peak ratio=-10
SNR=40;
//a)Determination of no. of bits/code
n=(SNR-(10*log10(3))-(-10))/(20*log10(2));
disp(n,'The no. of bits per code word is');
disp('Rounded off ','=8');
```

Scilab code Exa 11.3.2 example 2

```
clc;
//page no 393
//prob no. 11.3.2
//A telephone signal wih cut off freq=4kHz digitzed
   into 8-bit at nyquist sampling rate fs=2W
q=1;W=4*10^3;n=8;
```

```
//a)Determination of Tx Bandwidth
B=(1+q)*W*n;
disp('Hz',B,'a)The transmission BW is');
//b)Determination of quantization S/N ratio
SN_dB=6*n;
disp('dB',SN_dB,'b)The quantization S/N ration is');
```

Chapter 12

DIGITAL COMMUNICATIONS

Scilab code Exa 12.4.1 example 1

```
clc;
//page no 419
// problem no 12.4.1
//a binary polar waveform with following
    specifications are given
Vs_Vn=4;//SNVR
a=erf(4/sqrt(2));
b=erfc(4/sqrt(2));
Pbe=1/2 * b;// bit error probability
disp(a);
disp(b);
disp(Pbe,'The bit error probability');
```

Scilab code Exa 12.4.2 example 2

```
clc;
```

```
//page no 420
//problem no 12.4.2
//a binary unipolar waveform with following
    specifications are given
A=4;//max value of received signal voltage
Vn=0.5;//rms noise voltage
Vth=2;//Threshold voltage for the comparator
b=erfc(4/sqrt(2));
Pbe=1/2 * b;// bit error probability
disp(Pbe,'The bit error probability');
```

Scilab code Exa 12.4.3 example 3

```
clc;
//page no 421
//problem no 12.4.3
SNR=9;//SNR in dB
//conversion of dB to power ratio
p=10^(9/10);
// for Polar
Pbe1=1/2 * erfc(sqrt(7.94/2));
disp(Pbe1);
// for Unipolar
Pbe2=1/2 * erfc(sqrt(7.94)/2);
disp(Pbe2);
```

Scilab code Exa 12.5.1 exampple 4

```
clc;
//page no 423
//problem no 12.5.1
// binary unipolar signal is given
Pavg=6*10^-12;//in W
```

```
d=0.02*10^-6;//pulse duration in sec
T=550;//equivalent noise temp in K
Eb=Pavg*d;//avg energy per pulse
No=1.38*10^-23 *T;
r=Eb/No;
//Bit error probability is
Pbe=1/2 * erfc(sqrt(r/2));
disp(Pbe,'The bit error probability');
```

Scilab code Exa 12.9.1 example 5

```
clc;
//page no 435
//problem no 12.9.1
ENR=10;// energy to noise density ratio
Pbe1=1/2 * erfc(sqrt(ENR/2));
disp(Pbe1,'a)The bit error probability');
Pbe2=1/2 * %e^-(ENR/2);
disp(Pbe2,'b)The bit error probability');
```

Scilab code Exa 12.13.1 example 7

```
clc;
//page no 451
//problem no 12.13.1
//A 8 bit codewords
Pbec=0.01;n=8;i=3;
Pi=(Pbec^i)*((1-(Pbec))^(n-i));
Cin=(factorial(n))/(factorial(i)*factorial(n-i));
Pin=Cin*Pi;
P_in=Cin*Pbec^i
disp(Pin,'Pin=','The probability of a received
   codeword');
```

```
disp(P_in,'P_in');
```

Scilab code Exa 12.13.3 example 6

```
clc;
//page no 454
//problem no 12.13.3
SN_dB=9;
SNR=10^(SN_dB/10);
PbeU=1/2 * (1-erf(sqrt(SNR)));
BERu=PbeU;
disp(BERu,'a)The bit error probability');
n=10;k=n-1;
r=k/n;
SNR1=r*SNR;
PbeC=1/2 * (1-erf(sqrt(SNR1)));
BERc=(n-1)*PbeC^2;
disp(BERc,'b)The bit error probability');
```

Scilab code Exa 12.13.4 example 9

```
clc;
//page no 457
//problem no 12.13.4
//Tx link
SN_dB=8;
SNR=10^(SN_dB/10);
//a)Determination of bit error rate
PbeU=0.5*(1-erf(sqrt(SNR)));
BER_U=PbeU;
disp(BER_U,'a)The bit-error rate is');
//b)new bit error rate
n=15;k=11;t=1;r=k/n;
```

```
SNR_n=r*SNR;
PbeC=0.5*(1-erf(sqrt(SNR_n)));
BER_C=((factorial(n-1))*PbeC^(t+1))/((factorial(t))
    *(factorial(n-t-1)));
disp(BER_C,'The new bit error rate is');
```

Chapter 13

TRANSMISSION LINES AND CABLES

Scilab code Exa 13.5.2 example 1

```
clc;
//page no 475
//prob no. 13.5.2
// The attenuation coeff is 0.0006 N/m
a=0.0006;//The attenuation coeff in N/m
//a)Determinaion of the attenuation coeff in dB/m
a_dB=8.686*a;
disp('dB/m',a_dB,'The attenuation coeff is');
//b) Determination of attenuation coeff in dB/mile
k=1609;//conversion coeff for meter to mile
a_dB_mile=k*a_dB;
disp('dB/mile',a_dB_mile,'The attenuation coeff is')
    ;
```

Scilab code Exa 13.10.1 example 2

```
clc;
//page no 485
//prob no. 13.10.1
// Measurements on a 50 ohm slotted line gave
Z0=50;//measured in ohm
VSWR=2.0;
d=0.2;//distance from load to first minimum
T=(VSWR-1)/(VSWR+1);
pi=180;
Ql=pi*(4*0.2-1);
// using Euler's identity
e=cosd(Ql)+%i*sind(Ql);// expansion for e^(jQl);
a=T*e;
//Load impedance is given as
ZL=Z0*(1+a)/(1-a);
disp('ohm',real(ZL),'a) The equivalent  series
   resistance is');
disp('ohm',imag(ZL),'The equivalent  series
   reactance is');
disp('The minus sign indicate the capacitive
   reactance');
Yl=1/ZL;
disp('ohm',1/real(Yl),'b) The equivalent  parallel
   resistance is');
disp('ohm',1/imag(Yl),'The equivalent  parallel
   reactance is');
```

Scilab code Exa 13.11.1 `example 3`

```
clc;
//page no 488
//prob no. 13.11.1
d=0.1;//length of 50ohm short-circuited line
Z0=50;//in ohm
f=500*10^6;//freq in Hz
```

```
pi=180;
Bl=2*pi*d;
//a)Determination of equivalent inductive reactance
Z=%i*Z0*tand(Bl);
disp('ohm','i',Z,'The equivalent inductive reactance
    is');
//b)Determination of equivalent inductance
L_eq=Z/(2*%pi*f);
disp('nH',L_eq*10^9,'The equivalent inductance is');
```

Scilab code Exa 13.17.1 `example 4`

```
clc;
//page no 513
//prob no. 13.17.1
VSWR=2;l_min=0.2;Z0=50;
Ql=((4*l_min )- 1)*%pi;
tl=(VSWR-1)/(VSWR+1);
Tl=tl*%e^(%i*Ql);
Zl=Z0*(1+Tl)/(1-Tl);
disp('ohm',real(Zl),'a) The equivalent  series
   resistance is');
disp('ohm',imag(Zl),'The equivalent  series
   reactance is');
disp('The minus sign indicate the capacitive
   reactance');
Yl=1/Zl;
disp('ohm',1/real(Yl),'b) The equivalent  parallel
   resistance is');
disp('ohm',1/imag(Yl),'The equivalent  parallel
   reactance is');
```

Scilab code Exa 13.17.2 `example 5`

```
clc;
//page no 514
//prob no. 13.17.2
// A transmission line is terminated with
ZL=30-(%i*23);
l=0.5;//// length of line in m
Z0=50;//characteristic impedance in ohm
wl=0.45;//wavelength on the line in m
B=2*%pi/wl;
Tl=(ZL-Z0)/(ZL+Z0)
VI=1;//reference voltage in volt
VR=VI*Tl;
Vi=VI*%e^(%i*B*l);
Vr=VR*%e^-(%i*B*l);
V=Vi+Vr;
I=(Vi-Vr)/Z0;
Z=V/I;
disp('ohm',Z,'The input impedance is');
```

Scilab code Exa 13.17.3 example 6

```
clc;
//page no 515
//prob no. 13.17.3
Z0=600;Zl=73;//in ohm
F=0.9;
QF=(2*%pi*F)/4;
//For matching, the effective load impedance on the
   main line must equal the characteristic impedance
   of the mail line
Zl1=Zl;
Z01=sqrt(Zl1*Zl);
Tl=(Zl-Z01)/(Zl+Z01);
VI=1;//reference voltage
Vi=VI*%e^(%i*QF);
```

```
Vr=Tl*VI*%e^-(%i*QF);
V_in=Vi+Vr;
I_in=(Vi-Vr)/Z01;
Z_in=V_in/I_in;
disp('ohm',Z_in,'The input impedance is');
//the voltage reflection coeff is
TL_F=(Z_in-Z0)/(Z_in+Z0);
//the VSWr is given as
VSWR_F=(1+TL_F)/(1-TL_F);
disp(VSWR_F,'The VSWR is');
```

Chapter 14

WAVEGUIDES

Scilab code Exa 14.2.1 example 1

```
clc;
//page no 524
//prob no. 14.2.1
// A rectangular waveguide has a broad wall dimension as a=0.900 in. Therefore
a=2.286;//in cm
wl_c=2*a*10^-2;//in m
c=3*10^8;
wl=c/10^10;//in m
if(wl_c >wl)
    disp('i)TE10 wave will propogate');
else
    disp('i)TE10 wave will not propogate');
end
//determination of gide wl
wl_g=wl/(sqrt(1-(wl/wl_c)^2));
disp('cm',wl_g*10^2,'Guide wavelength is');
//determination of phase velocity
vp=c*wl_g/wl;
disp('m/s',vp,'Phase velocity is');
//determination of group velocity
```

```
vg=c*wl/wl_g;
disp('m/s',vg,'Group velocity is');
```

Chapter 15

RADIO WAVE PROPOGATION

Scilab code Exa 15.2.1 example 1

```
clc;
//page no 538
//prob no. 15.2.1
// satellite communication system is given
ht=36000;//height of satellite in km
f=4000;//freq used in MHz
Gt=15;//transmitting antenna gain
Gr=45;//receiving antenna gain
// A) Determination of free-space transmission loss
L=32.5+20*log10(ht)+20*log10(f);
disp('dB',L,'The free-space transmission loss is');
// B) Determination of received power Pr
Pt=200;//transmitted power in watt
Pr_Pt=Gt+Gr-L;//power ration in dB
Pr_Pt_watt=10^(Pr_Pt/10);//power ratio in watts
//Therefore
Pr=Pt*Pr_Pt_watt;
disp('watts',Pr,'The received power');
```

Scilab code Exa 15.2.2 example 2

```
clc;
//page no 539
//prob no. 15.2.2
// In the given problemhalf dipole antenna is given
Pr=10;//radiated power in watt
f=150;//freq used in MHz
d2=50;//distance of dipole in km
//we know for the half dipole the maximum gain is
   1.64:1,and the effectie length is wl/pi.
   Therefore open-ckt voltage induced is given as
Vs=sqrt(30*Pr*1.64)/(d2*10^3)*2/%pi;
disp('uV',Vs*10^6,'The open-ckt voltage induced is '
   );
```

Scilab code Exa 15.3.1 example 3

```
clc;
//page no 545
//prob no. 15.3.1
// VHF mobile radio system is given
Pt=100;//transmitted power
f=150;//freq used in MHz
c = 3*10^8;
d1=20;//height of transmitting antenna in m
Gt=1.64;//transmitting antenna gain
ht=2;//height of receiving antenna in m
d2=40;// distance in km
wl=c/(f*10^6);
E0=sqrt(30*Pt*Gt)
// Field strength at a receiving antenna is
```

```
ER=(E0*4*%pi*d1*ht)/(wl*(d2*10^3)^2);
disp('uV/m',ER*10^6,'Field strength at a receiving
    antenna is');
```

Scilab code Exa 15.3.2 example 4

```
clc;
//page no 548
//prob no. 15.3.2
ht1=100;ht2=60;//antenna heights in ft
dmax_miles=sqrt(2*ht1)+sqrt(2*ht2);
disp('miles',dmax_miles,'The maximum range is');
```

Scilab code Exa 15.4.1 example 5

```
clc;
//page no 560
//prob no. 15.4.1
ht=200;//virtual height in km
a=6370;//in km
B_degree=20;
B_rad=20*%pi/180;//angle of elevation in degree
// The flat-earth approximation gives
d=2*ht/tand(B_degree);
disp('km',d,'d=');
// By using radian measures for all angles
d=2*a*(((%pi/2)-B_rad)-(asin(a*cosd(B_degree)/(a+ht)
    )));
disp('km',d,'d=');
```

Scilab code Exa 15.7.1 example 6

```
clc;
//page no 574
//prob no. 15.7.1
// In this problem data regarding the sea water is
    given
conductivity = 4;//measured in S/m
rel_permittivity =80;
u=4*%pi*10^-7;
f1=100;//measured in Hz
f2=10^6;//measured in Hz
// A) first it is necessary to evaluate the ratio of
    conductivity/w*rel_permittivity
w1=2*%pi*f1;
r=conductivity/w1*rel_permittivity;
//after the calculation this ratio is much greater
    than unity. Therefore we have to use following eq
    to calculate the attenuation coeff as
a=sqrt(w1*conductivity*u/2);
disp('N/m',a,'The attenuation coeff is');
// By using the conversion factor 1N=8.686 dB
a_dB=a*8.686;
disp('dB/m',a_dB,'The attenuation coeff in dB/m is')
    ;
// B)
w2=2*%pi*f2;
r=conductivity/w2*rel_permittivity;
//after the calculation this ratio is much greater
    than unity. Therefore we have to use following eq
    to calculate the attenuation coeff as
a=sqrt(w2*conductivity*u/2);
disp('N/m',a,'The attenuation coeff is');
// By using the conversion factor 1N=8.686 dB
a_dB=a*8.686;
disp('dB/m',a_dB,'The attenuation coeff in dB/m is')
    ;
```

Chapter 16

ANTENNAS

Scilab code Exa 16.7.2 example 1

```
clc;
//page no 590
//prob no. 16.7.2
//For the Hertzian dipole, the radiation pattern is
   described by g(x)=sin^2(x) and g(y)=1
// Determination of -3dB beamwidth
// from the polar diagram shown we have
g_x=0.5;
x=asind(sqrt(g_x));
g_y=0.5;
y1=asind(sqrt(g_y));
y=y1+90;
//Therefore
z=y-x;
disp('degree',z,'The -3dB beamwidth is');
```

Scilab code Exa 16.9.1 example 2

```
clc;
//prob no. 16.9.1
//Half dipole antenna is given with I=Io*cos(Bl)
   where l=0
//The physical length of the antenna is wl/2
//consider wl=unity and current Io=unity
Io=1;
wl=1;
phy_length=wl/2;
I_av=2*Io/%pi;
//Thus area is given as
Area=I_av*phy_length;
// From the above eq l_effective is given as
disp('l_eff= wl/pi');
```

Scilab code Exa 16.19.1 example 3

```
clc;
//prob no. 16.19.1
// Paraboloida reflector antenna is given with
D=6;//reflector diameter in m
n=0.65;//illumination effeciency
f=10^10;//frequency of operation in Hz
c=3*10^8;//velo of light in m/s
wl=c/f;
A=(%pi*D^2)/4;
A_eff=n*A;
disp('m^2',A_eff,'Effective area is');
D0=4*%pi*A_eff/wl^2;
disp(D0,'The directivity is');
BW_dB=70*wl/D;
disp('degree',BW_dB,'The -3dB beamwidth is');
BW_null=2*BW_dB;
disp('degree',BW_null,'The null beamwidth is');
```

Chapter 17

Telephone Systems

Scilab code Exa 17.1.1 example 1

```
clc;
//page no 641
//problem no 17.1.1
//a)Determination of max gain1
FTL=50;M=12;
NFL=2*FTL;NFLG=(NFL-M);
G_max1=NFLG/2;
disp('dB',G_max1,'a)The max gain is');
//b)Determination of max gain2
IL=3;RLW=20;RLE=40;
NL=(4*IL)+RLW+RLE;
NLG=(NL-M);
G_max2=NLG/2;
disp('dB',G_max2,'The max gain is');
//c)Determination of amplr gain
LT=15;OM=6;
OLW=(RLW-LT)/2;
OLE=(RLE-LT)/2;
A=OM+OLW+OLE+(2*IL);
disp('dB',A,'The amplr gain is');
```

Chapter 18

FACSIMILE AND TELEVISION

Scilab code Exa 18.2.1 example 1

```
clc;
// page no 671
// prob no 18_2_1
//A drum of facsimile machine with diameter=70.4mm & scanning pitch=0.2mm/scan
D=70.4;P=0.2;
//Determination of index of co-operation
IOC_CCITT=D/P;
IOC_IEEE=IOC_CCITT*(%pi);
disp(IOC_IEEE,'The index of co-operation is');
```

Scilab code Exa 18.2.2 example 2

```
clc;
// page no 676
// prob no 18_2_2
```

```
//A drum scanner in eg.18.2.1 with pitch=0.26mm/line & diameter=68.4mm & drum rotate at 120rpm & scans lines=1075
D=68.4;P=0.26;rpm=120;n=1075;
//Determination of no. of pixels scan
Npx=(%pi)*(D/P);
disp('pixels/line',Npx,'The no. of pixels in scan line is');
//Determination of scan rate
Rs=rpm/60;
disp('lines/sec',Rs,'The scan rate is');
//Determination of pixel rate is
Rpx=Npx*Rs;
disp('pixels/sec',Rpx,'The pixel rate is');
f_max=Rpx/2;
//Determination of document Tx time
td=n/(60*Rs);
disp('min',td,'The document Transmission time is');
```

Scilab code Exa 18.3.1 example 3

```
clc;
//page no 693
//prob no. 18.3.1
a=(4/3);//aspect ratio
N=525;//no. of line periods per frame
Ns=40;//no. of suppressed lines
//Determination of no. of pixel periods in line period
Nv=N-Ns;
disp('lines',Nv,'The no. of pixel periods in line period is ');
//Determination of picture height and width
Nh=a*Nv;
disp('pixels',Nh,'The picture height is');
```

```
Nl=(Nh/0.835);
disp('pixels',Nl,'The picture length is');
```

Scilab code Exa 18.3.2 example 4

```
clc;
//page no 694
//prob no. 18.3.2
//A TV system with
N=525;P=30;
//Determination of horizontal and vertical
   synchhronization freq.
fh=N*P;
disp('Hz',fh,'the horizontal freq. is ');
fv=2*P;
disp('Hz',fv,'the vertical freq. is ');
//Determination of time reqd to scan one line
Th=(1/fh);
disp('sec',Th,'the time reqd to scan one line is ');
```

Scilab code Exa 18.3.3 example 5

```
clc;
//page no 695
//prob no. 18.3.3
//U.S. NTSC is given
//refer example 18.3.2
fh=15750;Nl=775;
//Determination of video bandwidth
Bv=0.35*fh*Nl;
disp('Hz',Bv,'the band width is');
```

Scilab code Exa 18.7.1 example 6

```
clc;
//page no 706
//prob no. 18.7.1
//refer example 18.3.1
a=4/3;//aspect ratio
D=48.26*10^-2;//CRT tube diagonal
Nh=647;
H=sqrt((a^2)*(D^2)/(1+a^2));
//Determination of viewing angle & minimum dist.
w=H/Nh;
theta=Nh*(1/60);//As each pixel subtend 1 minute of
    arc
disp('degree',theta,'The viewing angle is');
X=H/(2*tand(theta/2));
disp('m',X,'The min. viewing dist is');
```

Scilab code Exa 18.7.2 example 7

```
clc;
//page no 707
//prob no. 18.7.2
//HDTV system is given
//Refer example 18.7.1
a=16/9;D=1.40;Nh=1840;//Assuming square pixel
H=sqrt((a^2)*(D^2)/(1+a^2));
//Determination of viewing angle
theta=Nh*(1/60);
disp('degree',theta,'The viewing angle is');
//Determination of viewing dist
X=H/(2*tand(theta/2));
```

```
disp('m',X,'The viewing dist is');
```

Chapter 19

SATELLITE COMMUNICATIONS

Scilab code Exa 19.14.1 example 2

```
clc;
//page no 737
//problem no 19.14.1
//A high power amplr
P_HPA=600;TFL_dB=1.5;G_dB_ES=50;RFL_dB=1;GTR_dB_SAT
    =-8;FSL_dB=200;AML_dB=0.5;PL_dB=0.5;AA_dB=1;
//Determination of carrier to noise ratio
P_dB_HPA=10*log10(P_HPA/1);
EIRP_dB=P_dB_HPA-TFL_dB+G_dB_ES;
TPL_dB=FSL_dB+AML_dB+PL_dB+AA_dB;
CNoR_dB=EIRP_dB-TPL_dB-RFL_dB+GTR_dB_SAT+228.6;
disp(CNoR_dB,'The carrier to noise ratio in dB is');
```

Scilab code Exa 19.14.2 example 3

```
clc;
```

```
//page no 739
//problem no 19.14.2
f=14*10^9;BO_dB=10;GTR_dB_SAT=3;RFL_dB=1;phi_dB=-98;
    c=3*10^8;
//Determination of carrier to noise ratio
wav=c/f;
Ao_dB=10*log10((wav^2)/(4*(%pi)*1));
CNo_dB=phi_dB-BO_dB+GTR_dB_SAT-RFL_dB+Ao_dB+228.6;
disp(CNo_dB,'The carrier to noise ratio is');
```

Scilab code Exa 19.16.1 example 4

```
clc;
//page no
//problem no 19.16.1
//Determination of overall C/N
CNo_dB_U=88;CNo_dB_D=78;
NoC_U=10^(-CNo_dB_U/10);
NoC_D=10^(-CNo_dB_D/10);
NoC=NoC_U+NoC_D;
CNo_dB=10*log10(1/NoC);
disp(CNo_dB,'The overall carrier to noise ratio is')
    ;
```

Scilab code Exa 19.17.1 example 6

```
clc;
// page no 742
// prob no 19.17.1
// A digital satellite link is given with following
    specification
Eb_N0=9.6;//ratio expessed in dB
Rb=1.544*10^6;//bit rate expessed in bps
```

```
// The bit rate in dB relative to 1bps is
R_dB_b=10*log10(Rb) ;
//The required CN0 ratio is
CNo_db=Eb_N0+R_dB_b;
disp(CNo_db,'The ratio C/No is');
```

Chapter 20

Fiber Optic Communication

Scilab code Exa 20.2.1 example 1

```
clc;
// page no 753
// prob no 20.2.1
// An optic fiber is made of glass with following
   details
n1=1.55;//RI of glass
n2=1.51;//RI of clad
// NA of the fibe is given as
NA=n1*sqrt(2*(n1-n2)/n1);
disp(NA,'The numerical aperture is');
// Acceptance angle is given as
acc_angle=asind(NA);
disp(acc_angle,'The acceptance angle is');
```

Scilab code Exa 20.2.2 example 2

```
clc;
//page no 761
```

```
//prob no. 20.2.2
//refer example 20.2.1
d=50*10^-6;wav=0.8*10^-6;NA=0.352;
//Determination of V number
V=(%pi)*d*NA/wav
disp(V,'the V no. is');
//Determination of approximate number of modes
N=(V^2)/2;
disp(N,'the approximate no. of modes are ');
```

Scilab code Exa 20.2.3 example 3

```
clc;
//page no 763
//prob no. 20.2.3
d=5*10^-6;wave=1.3*10^-6;NA=0.35;
//Determination of V no.
V=(%pi)*d*NA/wave;
disp(V,'the v no. is' );
disp('from the table it is seen that 6 modes have
   cut off v less than 4.23 ');
```

Scilab code Exa 20.2.4 example 4

```
clc;
//page no 762
//prob no. 20.2.4
//refer example 20.2.3
a=2;//gradding profile index
V=69.1;//normalized cutoff freq.
N=2390;//number of modes supported as a step index
   fiber
```

```
//Determination of no. of modes supported by graded
   index fiber
N_a=(N*a)/(a+2);
disp(N_a,'no. of modes supported by graded index
   fiber');
```

Scilab code Exa 20.2.5 example 5

```
clc;
//page no 763
//prob no. 20.2.5
d=10*10^-6;wave=1.3*10^-6;n1=1.55;V_max=2.405clc;

//page no 762
//prob no. 20.2.4
NA=(V_max*wave)/(%pi*d);
//a)Dtermination of maximum normailized index
   difference
del=(1/2)*(NA/n1)^2;
disp(del,'a)the normilized index difference is');
//b)Determination of reffactive index of claddin
   glass
n2=n1*(1-del);
disp(n2,'b)cladding index required is');
//Determination of the fiber acceptance angle
theta_max=asind(NA);
disp(theta_max,'the max acceptance angle is');
```

Scilab code Exa 20.3.1 example 6

```
clc;
//page no
//prob no. 20.3.1
```

```
//A silica fiber with
A_max=25;A1=2;A2=0.3;
//a)Determination of repeater dist at 0.9um wavelength
z1=A_max/A1;
disp('km',z1,'a)the repeater dist for 0.9um wavelength is');
//b)Determination of repeater dist at 1.5um wavelength
z2=A_max/A2;
disp('km',z2,'a)the repeater dist for 1.5um wavelength is');
```

Scilab code Exa 20.4.1 `example 7`

```
clc;
//page no 772
//prob no. 20.4.1
//Refer example 20.4.1
n1=1.55;del=0.0258;l=12.5;z=1000;c=3*10^8;
//a)Determination of intermodal dispersion
del_per_km=(n1*z*del)/((1-del)*c);
disp('s/km',del_per_km,'the intermodal dispersion is');
//b)Determination of intermodal dispersion for l=12.5
del_l=del_per_km*l/1000;
disp('s',del_l,'the intermodal dispertion for l=12.5 is');
```

Scilab code Exa 20.4.2 `example 13`

```
clc;
```

```
//page no 773
//prob no. 20.4.2
//Refer example 20.4.1
n1=1.55;del=0.0258;z=1000;c=3*10^8;z_disp=12.5;
del_graded=(n1*z*del^2)/(8*c);
//Determination of intermodal dispersion
del_total=del_graded*z_disp;
disp('sec',del_total,'the intermodal dispersion is')
    ;
```

Scilab code Exa 20.4.3 example 8

```
clc;
//page no 774
//prob no. 20.4.3
//Refer example 20.4.1
wav_0=0.8*10^-6;Dm=-0.15;wav_3=1.5;z=12.5;
del_t=Dm*wav_3;
//Determination of total material dispersion
del_md=del_t*z;
disp('ns',del_md,'The total material dispersion is')
    ;
```

Scilab code Exa 20.4.4 example 9

```
clc;
//page no 775
//prob no. 20.4.4
Dm=6.6;z=12.5;del_3=6;
del_wg=Dm*z*del_3;
disp('ps',del_wg,'Expected waveguide dispersion is')
    ;
```

Scilab code Exa 20.4.5 example 10

```
clc;
//page no 776
//prob no. 20.4.5
del_imd=0;del_md=2.81;del_wgd=0.495;t_w=2.5;
del_tot=((del_imd^2)+(del_md^2)+(del_wgd^2))^(1/2);
disp('ns',del_tot,'The total dispersion is');
t_r=((t_w^2)+(del_tot^2))^(1/2)
//Determination of max allowed bit rate
B=(1000/(2*t_r));
disp('Mbps',B,'The max allowed bit rate is');
```

Scilab code Exa 20.4.6 example 11

```
clc;
//page no 778
//prob no. 20.4.6
//A multimode step index fiber
del_t=4;B=10;
//a)Determination of BW distance product
BDP=1/(2*del_t);
disp('Mbps-km',BDP,'a)The BW distance product for fiber is');
//b)Determiation of dispersion limited length
z_max_disp=BDP/(B*10^-3);
disp('km',z_max_disp,'b)The disp limited length for a fiber is');
```

Scilab code Exa 20.5.1 example 14

```
clc;
//page no 780
//prob no. 20.5.1
//3 semiconductor diodes are given
E1=1.9;E2=1.46;E3=0.954;eV=1.9;//All in eV
c=3*10^8;//speed of light
//a)Determination of wavelength and freq for E1=1.9
wav1=1.241/E1;f1=c/(wav1*10^-6);
disp('um',wav1,'a)i)the wavelength is');
disp('Hz',f1,'a)ii)the freq is');
//b)Determination of wavelength and freq for E2=1.46
wav2=1.241/E2;f2=c/(wav2*10^-6);
disp('um',wav2,'b)i)the wavelength is');
disp('Hz',f2,'b)ii)the freq is');
//c)Determination of wavelength and freq for E3=0.945
wav3=1.241/E3;f3=c/(wav3*10^-6);
disp('um',wav3,'c)i)the wavelength is');
disp('Hz',f3,'c)ii)the freq is');
```

Scilab code Exa 20.8.1 example 12

```
clc;
//page no 799
//prob no. 20.8.1
//A fiber link is given
pt=0;pr=-57;Nc=2;BER=10^-9;N=5;Lpt=6;Lpr=6;Lc=1;Ls=0.5;Lf=2;M=5;del_t=0.505;B=35;Ns=5;
//a)Determination of loss-limited fiber length
z=(pt-pr-M-(Nc*Lc)-(Ns*Ls)-Lpt-Lpr)/Lf;
disp('km',z,'a)the loss-limited fiber is');
//b)Determination of max BW for loss-limited fiber length
```

```
B_max=1/(5*del_t*z);
disp('Gbps',B_max,'b)the max BW for loss-limited
    length is');
//c)Determination of dispersion-limited length
z_disp=1000/(5*del_t*B);
disp('km',z_disp,'the dispertion limited length is')
    ;
```